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SEASONAL OCCURRENCE, DISTRIBUTION, AND ABUNDANCE OF LARVAL BLUEFISH, *POMATOMUS SALTATRIX* (FAMILY: POMATOMIDAE), IN THE NORTHERN GULF OF MEXICO

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ABSTRACT

Few bluefish larvae have been reported from Gulf of Mexico waters, although adults are relatively common in the north-central and western gulf. We submit that the paucity of information on larval bluefish is an artifact resulting from inadequate sampling at the appropriate times and locations. We provide data on seasonal occurrence, distribution, and abundance of bluefish larvae from gulfwide surveys. Seasonal occurrence of larvae reported herein support adult gonad maturation data that spawning is bimodal and occurs during April and October–November. Larval bluefish in the gulf occur at water temperatures primarily between 22° and 25°C, at salinities >30‰, inside the 100 m isobath, and between 88°00′ and 93°00′W longitude. Bluefish larvae are rare in the eastern gulf off Florida. Based on an estimated egg incubation period of 30–36 h at 25°C and the size of most early larvae in our collections, we conclude that bluefish spawn in the sampling area. Spawning may be centered around hydrographically dynamic areas as evidenced by higher densities in riverine/oceanic frontal zones.

The bluefish, *Pomatomus saltatrix,* is a monotypic, pelagic, migratory species of worldwide distribution (Briggs, 1960) except for the eastern Pacific (Kendall and Walford, 1979). Bluefish support a large recreational fishery along the U.S. Atlantic coast (Thompson, 1986), ranking either first or second in number of fish caught between 1979 and 1985 (Holliday, 1986). In the Gulf of Mexico (gulf), tenative estimates of bluefish standing stock range from 18,000 to 22,500 metric tons (Juhl, 1976). About 72% of total gulf recreational catch of bluefish is from Louisiana and Texas waters, with 90% caught within 3 miles of shore (Holliday, 1986). Two bluefish bioprofiles have been compiled but contain information collected primarily along the U.S. Atlantic coast (Wilk, 1977; Pottern et al., 1989). Egg and larval development are illustrated and described (Pearson, 1941; Deuel et al., 1966; Norcross et al., 1974; Finucane et al., 1979), but published information on the early life stages from the gulf are limited to Barger et al. (1978), Benson (1982), and Ditty et al. (1988). Information on the occurrence of young bluefish in the gulf is based largely on the collection of 18 larvae from one transect of seven stations off south Texas during November 1976 and 1977 (Barger et al., 1978). The areal and temporal distribution of spawning has not been described. Our objective is to describe the seasonal occurrence, distribution, and abundance of young bluefish in the gulf.

Materials and Methods

Southeast Area Monitoring and Assessment Program (SEAMAP) plankton surveys have been conducted in the gulf since 1982 to determine the seasonality, distribution, and abundance of larval and juvenile fishes. We examined samples taken during SEAMAP surveys between 1982 and 1986[1] for larval and juvenile bluefish. Standard ichthyoplankton survey techniques (Smith and Richardson, 1977) were employed in data collection. Stations sampled by National Marine Fisheries Service (NMFS)

[1] SEAMAP. 1983–1987. (plankton.) ASCII characters. Data for 1982–1986. Fisheries-independent survey data National Marine Fisheries Service, Southeast Fisheries Center: Gulf States Marine Fisheries Commission, Ocean Springs, Mississippi (producer).

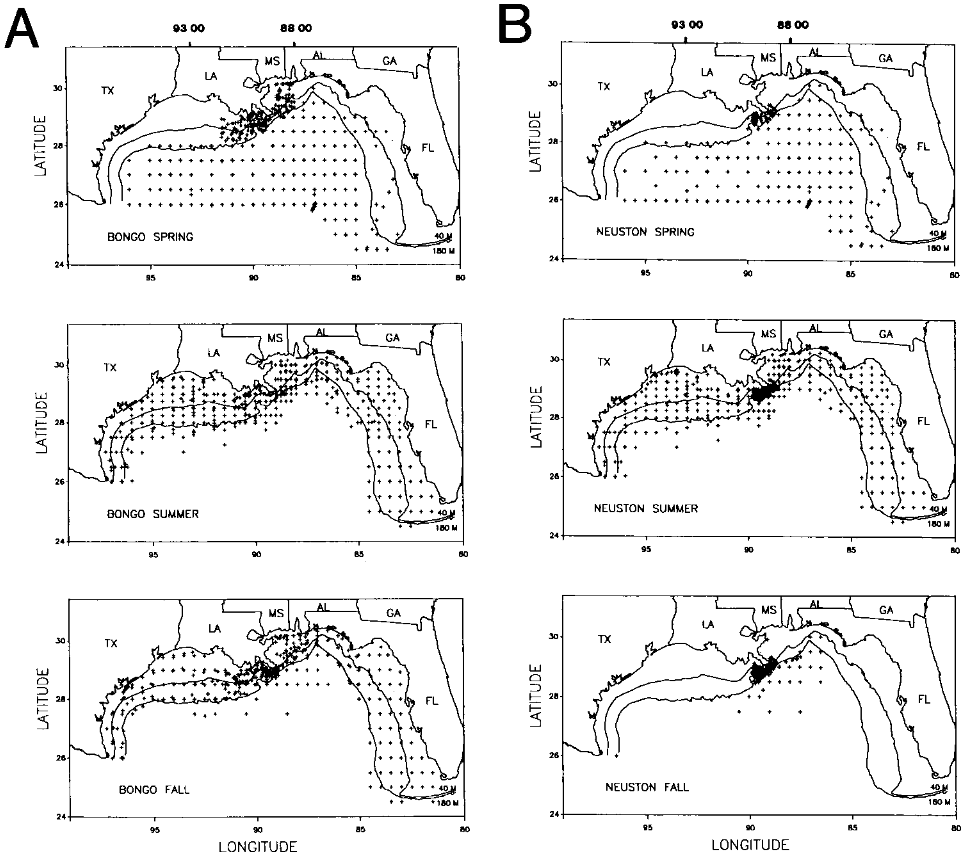

Figure 1. Distribution of stations sampled in the northern Gulf of Mexico for young bluefish (*Pomatomus saltatrix*). Spring (March to May), summer (June to August), and fall (September to November). A. 60-cm bongo net stations. Solid triangle off Mississippi River delta is location of Tucker trawl and MOCNESS samples. B. 1 × 2 m neuston net stations.

vessels were arranged in a systematic grid at about 55 km-intervals. NMFS vessels primarily sampled waters >10 m deep. Each cooperating state had its own sampling grid and primarily sampled their coastal waters. Hauls were continuous and made with a 60-cm bongo net (0.333 mm mesh) towed-obliquely from within 5 m of the bottom or from a maximum depth of 200 m. A flowmeter was mounted in the mouth of each net to estimate volume of water filtered. Ship speed was about 1.5 kn; net retrieval was 20 m·min^{-1}. At stations <95 m deep, tow retrieval was modified to extend a minimum of 10 min in clear water or 5 min in turbid water. Tows were made during both day and night depending on when the station was occupied. Latitude 24°30′N was the southern boundary of the study area in the eastern gulf, a cutoff which approximates the continental shelf break (i.e., 180 m depth contour) along the southern tip of Florida; longitude 81°00′W was the eastern boundary. Latitude 26°00′N was the southern boundary of our survey area in the central and western gulf (Fig. 1). Overall, 1,825 bongo net tows were taken during the 5-year period. The SEAMAP effort from 1982 through 1984 also involved the collection and processing of 814 samples taken with an unmetered 1 × 2 m neuston net (0.947 mm mesh) towed for 10 min. During April and May, SEAMAP collections were taken primarily beyond the continental shelf in conjunction with NMFS annual larval tuna surveys. Sampling during March, and from June through November was conducted primarily over or immediately adjacent to the shelf. About 55% of samples during December (N = 108) were over the shelf immediately west of the Mississippi River delta, and 45% were in oceanic waters. No samples were collected during January and February. Of the 1,717 bongo net samples taken between March and November, 12.5% were over the shelf during spring (March–May), 34.5% were over the shelf during summer (June–August), and 20.8% were over the shelf during fall (September–November). Overall, 39.1% of the 1,717 samples were at stations <40 m deep, 28.8% were at stations between 40 and 180 m deep, and 32.1% were at stations >180 m deep. Neuston net stations were similarly distributed (Fig. 1). Additional information on the temporal and spatial coverage of SEAMAP plankton surveys is found in Stuntz et al. (1985), Thompson and Bane (1986a, 1986b), Thompson et al. (1988), and Sanders et al. (1990).

Collections from within riverine/oceanic frontal zones off the Mississippi River delta were also examined for larval and juvenile bluefish (Appendix Table 1). We examined 63 surface-towed 1 m^2 Tucker trawl (0.333 mm mesh) samples taken at seven stations during July 1987, and 45 surface-towed 1 m^2 MOCNESS (Wiebe et al., 1976) samples (0.333 mm mesh) collected at five stations during April 1988.[2] In addition, we examined 311-1 × 2 m neuston net (0.947 mm mesh) samples from May, August, September, and December collected by personnel of the National Marine Fisheries Service (NMFS, Panama City Lab, Florida) between 1986 and 1989 (Appendix Table 1). Frontal zone samples were collected during the day. We also examined 17 samples from stations <100 m deep taken off Louisiana during October 1990. The sampling area extended 140 km west from Southwest Pass of the Mississippi River delta along the inner to mid-shelf. These samples were collected with a 60-cm bongo net (0.333 mm mesh) towed obliquely to the surface from within 5 m of the bottom or from a maximum depth of 50 m (Appendix Table 1).

Temperature and salinity data were taken at the sea surface. Hydrographic data were multiplied by total number of larvae collected at each station to obtain median and mean station depth, water temperature, and salinity values. This method of calculating hydrographic data gives weight to distribution of larvae rather than to distribution of stations. An univariate method was used to calculate median and mean statistics (SAS Institute, 1985). All length measurements were standard length (SL) unless stated otherwise.

Estimates of larval density (# larvae$\cdot$100 m^{-3}) and abundance (# larvae$\cdot$10 m^{-2}) were calculated for each station where larvae were collected (i.e., positive catch station) (Appendix Table 2). Estimates of monthly density at positive catch stations were also calculated (Table 1). Data were combined by month across years because each month was not sampled every year. Monthly density estimates were calculated by dividing sum of larvae collected by month and gear, by sum of positive catch station volume of water filtered for that month and gear, and multiplying the result by 100. Monthly abundance estimates at positive stations were also calculated and multiplied by 10. Monthly density and abundance estimates were not calculated for bongo net tows taken during April and May because sampling was primarily beyond the shelf at stations >200 m deep and only two positive catch stations occurred each month (Appendix Table 2). In addition, monthly estimates for October and for November were calculated at stations <100 m deep and between longitude 88°00′ and 93°00′W because only five larvae were collected east and one larva west of these coordinates during this time period (Fig. 1, Appendix Table 2). Samples beyond the shelf during April and May, and outside 88°00′ and 93°00′W during October and November were eliminated from estimates because these were locations where larvae seldom occurred.

Results

A total of 70 bluefish larvae were taken in bongo net collections (Appendix Table 2), at surface water temperatures of 22.4–26.9°C (mean: 24.6°C, median: 25.3°C) and salinities of 26.7–36.3‰ (mean: 33.0‰, median: 34.3‰). Most bluefish larvae (94%) collected in bongo nets were taken during October–November at stations with a median depth of 37 m. All larvae collected during October–November were found at stations inside 100 m, except two larvae from neuston nets at a station 1,383 m deep (Appendix Table 2). Three larvae were collected at bongo net stations during April (2.1–3.5 mm) and one larva during May (5.2 mm). Another larva was taken in neuston net collections during May (6.5 mm) (Appendix Table 2). The two larvae from May (5.2 and 6.5 mm) were collected on 1 and 2 May 1983 and were spawned during late April. Few bluefish larvae were collected at stations east of 88°00′W or west of 93°00′W longitude (Fig. 2, Appendix Table 2).

Four hundred and forty-two larval bluefish were collected in 43 of 45 MOCNESS samples taken within riverine plume/oceanic frontal zones off the Mississippi River delta during April 1988 (Fig. 2). Mean surface water temperature and

[2] Louisiana State University, Coastal Fisheries Institute, Baton Rouge.

Table 1. Comparison of larval bluefish density (#·100-m³) and abundance (#·10-m²) estimates by month for the Gulf of Mexico and U.S. South Atlantic Bight. Estimates are for positive catch bongo net stations only. Monthly density estimates are calculated by dividing sum of larvae by month by sum of volume water filtered at positive catch stations for that month and multiplying the result by 100. Months are combined across years. Range is individual station density or abundance estimates for that month.

Month	Gear	Total # larvae	# Pos/total samples	Density mean (range)	Abundance mean (range)	Location
This study						
October	B[1]	39	17/130	2.0 (0.6–10.2)	7.3 (2.9–22.5)	North-central Gulf, 88°00′ to 93°00′W longitude
November	B[1]	21	9/110	2.1 (0.7–14.3)	6.8 (1.7–32.9)	North-central Gulf, 88°00′ to 93°00′W longitude
April	M[2]	442	5/209	6.9 (3.6–10.8)		Mississippi River frontal zone, off Louisiana
Barger et al. (1978)						
November	B[3]	18	7/14	0.5 (0.2–1.5)	3.7 (1.3–11.4)	Off south Texas
McGowan (1985)						
November	B[4]	20	11/43	1.2 (0.3–2.0)	5.0 (1.0–13.0)	Over Flower Garden Banks off Galveston, Texas
Collins and Stender (1987)						
March	B[5]/N[6]	3,881[7]	28/565[8]	0.5[10]/0.3[11]	6.3[12]	U.S. South Atlantic
April	B/N		65/598[9]	4.5/4.6	45.3	Bight from Cape
May	B/N			5.4/4.2	39.6	Hatteras, North Car-
September	B/N			1.6/2.2	5.5	olina to Cape Ca-
November	B/N			1.0/0.3	4.9	naveral, Florida

[1] 60 cm bongo net, 0.333-mm mesh, oblique-tow from depth.
[2] 1-m² MOCNESS, 0.333-mm mesh, 3 min surface-tow for each of nine nets at each station.
[3] 60 cm bongo net, 0.333- and 0.505-mm mesh, oblique-tow from depth.
[4] 60 cm bongo net, 0.333-mm mesh, double-oblique tow.
[5] 60 cm bongo net, 0.505-mm mesh, double-oblique tow.
[6] 1 × 0.5 m neuston net, 0.505 mm mesh; or, 2 × 1 m neuston net, 0.947 mm mesh; both neuston nets towed half-submerged.
[7] Total number of larvae collected in both bongo and neuston net tows for all months sampled.
[8] Number of bongo net samples.
[9] Number of neuston net samples.
[10] Mean density for bongo net samples by month.
[11] Mean density for neuston net samples.
[12] Mean abundance for bongo net samples only.

salinity was 22.4°C (range: 21.7–22.7°C) and 33.3‰ (range: 29.4–36.0‰); station depths ranged from 73 to 101 m (Appendix Table 2). Monthly density estimates for positive catch stations during April 1988 were 3.5 times higher in frontal zones than in bongo net samples collected over the continental shelf during October or November (Table 1).

Discussion

We found that surface water temperatures and salinities in the northern gulf during months when larvae are collected (range: 21.7–26.9°C, and >30‰) coincide with those reported for spawning by Barger et al. (1978) off Texas, along the U.S. Atlantic coast (Norcross et al., 1974) and in the northwest Mediterranean (Sabates and Martin, 1993). Minimum surface water temperatures and salinities for the onset of bluefish spawning along the U.S. Atlantic coast are 17–18°C and 26.6‰ (Norcross et al., 1974; Kendall and Walford, 1979). At 25°C, bluefish eggs hatch at 30–36 h based on Pauly and Pullin's (1988) relationship between egg

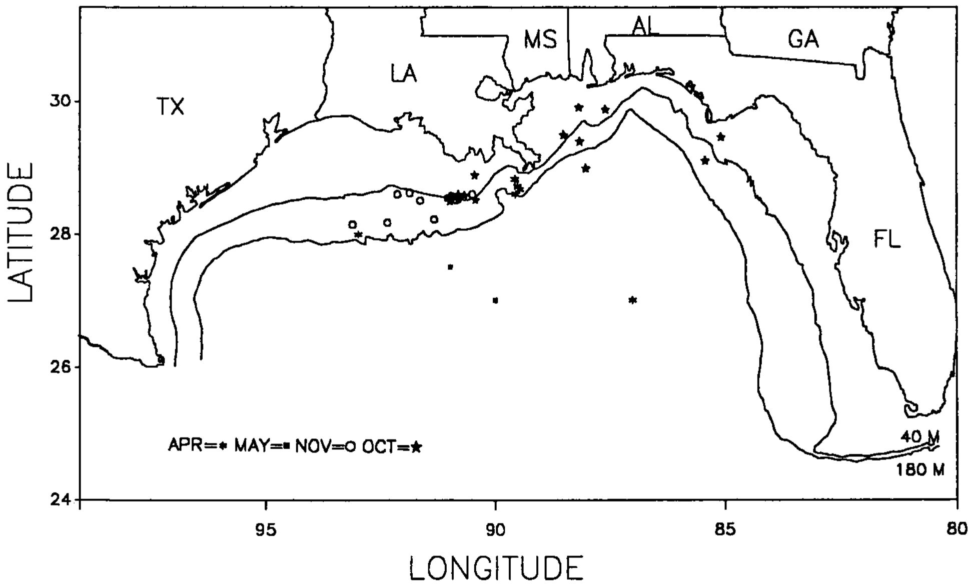

Figure 2. Locations where young bluefish (*Pomatomus saltatrix*) were collected in the northern Gulf of Mexico.

diameter and water temperature to predict development time. Hatching time increases to 44–48 h at mean water temperatures of 20°C (Salekhova, 1959; Deuel et al., 1966; Norcross et al., 1974). Bluefish larvae hatch at about 2.0–2.2 mm total length (TL) (Deuel et al., 1966; Norcross et al., 1974; Sabates and Martin, 1993). Most larvae we examined are <4.0 mm SL (Appendix Table 2) and probably between 2 and 4 days post-hatch based on laboratory growth rates (Deuel et al., 1966). The small sizes of our larval bluefish and relatively warm surface water temperatures when larvae are collected suggest that spawning occurs in the sampling area.

We found only two larvae during extensive sampling of waters >180 m deep during April when larvae are present nearer shore suggesting that spawning in the gulf occurs primarily over the shelf (Appendix Table 2). Furthermore, all but two larvae we found during October and November, and 16 of 18 larvae collected by Barger et al. (1978) off Texas occurred at stations ≤100 m deep. Distribution data for adults in the north-central gulf support these findings. All adult bluefish collected in NMFS fall surveys of north-central gulf waters since 1972 occurred inside 80 m (peak mean catch rates occurred between 55 and 65 m, pers. comm., Dr. Scott Nichols, NMFS, SEFC, Pascagoula Laboratory, Pascagoula, Mississippi 39568). Bluefish eggs and larvae are primarily found at stations 50 to 100 m deep off Senegal, West Africa (Conand and Franqueville, 1973), and inside the 100 m isobath in the northwest Mediterranean (Sabates and Martin, 1993). The seaward extent of historical ichthyoplankton surveys off the Mid-Atlantic (Cape Hatteras, North Carolina to southern New Jersey) and South Atlantic Bights (Cape Hatteras to southern Florida) have been limited primarily by the 200 m isobath, but bluefish eggs and larvae are most frequently found over the outer shelf (Norcross et al., 1974; Kendall and Walford, 1979; Collins and Stender, 1987).

The geographical distribution of larvae and adults, and recreational catch data for the gulf suggest that bluefish are most common off Louisiana and Texas and rare in the eastern gulf off Florida. We found only three bluefish larvae east of 87°00′W longitude (Fig. 2). This finding agrees with Houde et al. (1979) who did not collect larval bluefish in a previous survey of eastern gulf waters off Florida during 1971–1974. Adults are caught primarily in the north-central and western gulf, with 72% of the marine recreational catch from Louisiana and Texas waters (Holliday, 1986).

Historical information on seasonal occurrence of larvae (Ditty et al., 1988) supports gonad maturation data (Finucane et al., 1980) from the gulf and indicates that spawning occurs from late September through early November but also during April. Our data support bimodal spawning during April and October–November because we found no bluefish larvae or juveniles during extensive sampling of continental shelf waters during March or between June and September (Fig. 1). Furthermore, we found no larval or juvenile bluefish in Tucker trawl or neuston net tows in Mississippi River delta waters during May, July, August, September, or December. In some fishes, rapid increases or decreases in water temperature stimulate maturation and ovulation, with increments as small as 4°C able to initiate spawning (Bye, 1990). If bluefish spawning in the gulf is associated with rapidly rising and falling water temperatures that average between 22° and 26°C (surface temperatures when larvae are primarily collected), then conditions such as these are found in the gulf during March and April, and again during October and November. Alternately, bimodal spawning could suggest separate populations that spawn at different times. Three separate bluefish spawning concentrations occur along the U.S. Atlantic coast: 1) a spring-spawned cohort produced between March and May during the northward migration of adult bluefish; 2) a summer-spawned cohort produced between June and August in the Mid-Atlantic Bight; and, 3) a fall-spawned cohort produced in the South Atlantic Bight between September to November (Norcross et al., 1974; Kendall and Walford, 1979; Collins and Stender, 1987).

Few bluefish larvae or juveniles have been reported in previous surveys of gulf waters, although adults are relatively common in the north-central and western gulf. This apparent paucity of information on young bluefish may be a sampling artifact since most gulf surveys have been conducted during months outside bluefish spawning season or at locations beyond the continental shelf. We collected 70 bluefish larvae in oblique bongo net tows, and Barger et al. (1978) and McGowan (1985) caught 38 overall using similar methodology. We found only three bluefish in neuston net tows (Appendix Table 2). Of the 814 neuston net samples collected, 95 are from April and 37 are from October–November; however, only three of these collections are from stations <180 m deep. We collected 442 larvae in surface MOCNESS tows; unfortunately, we only have MOCNESS collections in the delta area during April and do not have comparable data for October–November. Barger et al. (1978) did not find young bluefish in neuston tows; however, they took only 14 total neuston samples during November over 2 years. McGowan (1985) did not use surface-towed nets.

Positive station density and abundance estimates from other gulf and Atlantic coast surveys are comparable to those we found (Table 1). Barger et al. (1978) did not sample during October or collect bluefish larvae during April; McGowan (1985) did not collect larval bluefish during October or April. In general, estimates of larval bluefish abundance from Marine Resources Monitoring, Assessment, and Prediction (MARMAP) surveys (Sherman et al., 1984) are considerably higher than those from the gulf.

The observation that peak spawning during June in the Mid-Atlantic Bight coincides with increasing zooplankton abundance led Sherman et al. (1984) to postulate that bluefish have developed a spawning strategy that optimizes encountering prey. We believe that spawning in the gulf may be associated with hydrographically dynamic areas as evidenced by a 3.5 times higher density and greater frequency of occurrence in frontal zones off the Mississippi River delta during April when compared to waters around the delta during October–November (Table 1). This hypothesis is further reinforced by observations of spawning associated with current shear zones off Cape Hatteras and in convergence zones off the New York Bight (Shima, 1989), in an upwelling area of the South Atlantic Bight produced by the Charleston bump (Collins and Stender, 1987), and near fronts off West Africa (Conand and Franqueville, 1973). Frontal zones and upwelling areas may offer enhanced opportunities for feeding and growth of larvae because of potentially elevated phytoplankton and zooplankton biomass in these areas (Govoni et al., 1989; Grimes and Finucane, 1991), although the inferred nutritional advantage that these zones offer has not been consistently demonstrated (Powell et al., 1990). Higher densities in Mississippi River frontal zones may also reflect either increased sampling efficiency of the MOCNESS methodology or sampling bias since bluefish larvae are surface-oriented. A possible association with riverine frontal areas requires further study.

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Appendix Table 1. Summary of total number of bongo net/neuston net stations examined for bluefish larvae (*Pomatomus saltatrix*) in the Gulf of Mexico. Acronyms are as follows: SEAMAP = Southeast Area Monitoring and Assessment Program; NMFS = National Marine Fisheries Service, Panama City, Florida; LSU = Louisiana State University. NS means no samples.

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SEAMAP										
1982	77*/0†	69/68	71/73	102/100	26/24	NS	NS	3/8	29/3	NS
1983	15/13	27/27	84/84	55/45	44/42	NS	NS	39/26	NS	24/23
1984	23/0	44/0	46/0	55/54	20/26	155/162	NS	24/0	6/0	36/36
1985	29/0	NS	NS	85/0	39/0	69/0	20/0	4/0	2/0	24/0
1986	NS	24/0	90/0	57/0	10/0	NS	145/0	43/0	73/0	24/0
Total	144/13	164/95	291/157	354/199	139/92	224/162	165/0	113/34	110/3	108/59
NMFS										
1986							46			
1987							68			
1988			55			71				36
1989							35			
LSU										
1987‡					63					
1988§		45								
1990*								17		

* 60 cm bongo net, 0.333-mm mesh, oblique-tow from depth.
† 1 × 2 m neuston net, 0.947-mm mesh, 10 min surface-tow, unmetered.
‡ 1-m^2 Tucker trawl, 0.947-mm mesh, 3 min surface-tow each net, nine net collections/station, seven total stations.
§ 1-m^2 MOCNESS, nine nets of 0.333-mm mesh, 3 min surface-tow each net, five total stations.

Appendix Table 2. Positive catch station data for bluefish (*Pomatomas saltatrix*) larvae collected in the northern Gulf of Mexico (gear codes are: B = bongo net, N = Neuston net, M = MOCNESS)

Station	Date	Gear	Latitude	Longitude	Station depth (m)	°C	‰	No.	Length (mm SL)	#·100-m³	#·10-m²
SEAMAP*											
2223	4-84	B	27°00	87°00	2,970	26.1	—	2	2.8–3.5	0.4	8.9
5026	4-86	B	28°00	93°00	106	22.4	—	1	2.1	0.7	6.2
1225	5-83	N	27°00	90°00	2,286	22.4	35.3	1	6.5	—	—
1236	5-83	B	27°30	90°59	1,116	23.0	36.3	1	5.2	0.2	4.8
3399	10-83	N	29°00	88°01	1,383	25.4	35.1	2	5.2–9.2	—	—
3419	10-83	B	29°53	87°35	33	—	—	2	3.2–4.9	1.4	4.3
3570	10-84	B	29°55	88°10	31	26.4	35.0	2	3.4–5.3	1.7	4.9
3576	10-84	B	29°24	88°09	55	26.1	—	1	3.7	1.0	4.9
3605	10-84	B	28°32	90°26	37	26.5	34.0	1	2.6	1.0	3.8
3609	10-84	B	28°31	90°59	77	26.8	34.3	1	5.1	0.6	4.7
4503	10-85	B	28°33	90°48	26	26.9	34.0	2	5.0–6.0	2.0	4.6
6178	10-86	B	29°07	85°25	46	25.9	35.7	2	2.9–3.2	2.2	10.6
6181	10-86	B	29°28	85°05	13	24.4	34.9	1	5.5	2.6	2.9
6220	10-86	B	29°30	88°30	49	25.3	35.6	1	5.0	1.1	5.4
6488	10-86	B	28°36	90°40	20	23.4	28.3	3	2.2–7.7	3.8	7.3
6494	10-86	B	28°37	90°48	18	23.5	30.7	4	2.4–4.2	4.9	8.9
6498	10-86	B	28°35	90°57	22	23.8	33.0	9	2.4–3.1	10.2	22.5
6508	10-86	B	28°35	90°58	22	22.8	31.3	2	2.3	1.8	4.0
6511	10-86	B	28°37	90°48	18	22.6	29.3	2	2.8	2.2	3.8
6549	10-86	B	28°54	90°27	16	22.7	26.7	2	4.2	3.1	4.9
2086	11-82	B	28°33	91°02	29	24.1	34.9	1	3.3	0.8	1.7
3611	11-84	B	28°35	90°58	22	25.3	34.0	1	2.6	1.5	3.6
3619	11-84	B	28°14	91°20	77	23.8	34.9	1	3.3	0.7	5.2
3621	11-84	B	28°38	91°52	39	25.5	34.9	2	3.0–3.8	1.8	7.0
6244	11-86	B	28°37	90°30	25	24.4	31.6	1	3.4	1.9	3.1
6250	11-86	B	28°31	90°51	31	24.6	32.6	7	2.7–7.2	14.3	32.9
6259	11-86	B	28°11	92°21	74	25.8	35.5	6	3.0–4.0	5.1	3.3
6262	11-86	B	28°37	92°08	40	25.3	35.8	1	3.5	1.2	3.7
6265	11-86	B	28°31	91°38	50	25.4	35.8	1	4.6	1.2	4.9
6286	11-86	B	28°09	93°07	73	25.3	36.2	1	4.6	0.5	3.0
LSU†											
1	4-88	M	28°37	89°33	101	22.7	36.0	92	2.4–4.2	7.6	688.0
3	4-88	M	28°41	89°27	99	22.4	34.0	54	2.8–7.9	3.6	320.0
4	4-88	M	28°43	89°30	97	22.5	33.7	107	2.8–5.5	7.4	649.0
5	4-88	M	28°50	89°34	74	22.5	32.6	126	2.2–7.9	10.8	80.0
6	4-88	M	28°50	89°33	73	21.7	29.4	63	2.2–5.8	4.7	34.5
1-A	10-90	B	28°43	89°30	100	—	—	2	2.0–2.4	2.2	12.8
11-B	10-90	B	28°30	90°15	50	25.8	35.0	1	3.5	1.4	6.3
12-B	10-90	B	28°30	90°32	37	25.7	34.0	2	3.0–3.3	3.8	11.7
13-A	10-90	B	28°40	90°32	19	23.0	36.0	1	4.3	3.3	4.2
15-B	10-90	B	28°49	90°00	39	23.9	32.1	3	1.8–4.2	5.1	13.7

* Southeast Area Monitoring and Assessment Program.
† Louisiana State University, Coastal Fisheries Institute, Baton Rouge.